

WE CLAIM:

1. A coating composition that is curable in air to a protective film, comprising a binder and a reactive diluent that comprises one or more carboxylic acids with the formula  $R^1-(C=O)-OH$ , where  $R^1$  has 8 to 35 carbons and includes an ester linkage.
2. The coating composition of claim 1, where the coating composition has a volatile organic compound content of less than 30 grams per liter.
3. The coating composition of claim 1, where  $R^1$  has the formula  $R^2-(C=O)-O-R^3$ ,  $R^2$  is a moiety of 3 to 23 carbons, and  $R^3$  is a linker of 1 to 16 carbons.
4. The coating composition of claim 3, where  $R^2$  has 8 to 21 carbons.
5. The coating composition of claim 3, where  $R^3$  has 2 to 4 carbons.
6. The coating composition of claim 1, where the binder is an alkyd that is present at a concentration of up to about 15% by weight.

7. The coating composition of claim 6, where the alkyd and reactive diluent are present in a weight ratio of about 5:1 to about 1:5.

8. The coating composition of claim 1, where the reactive diluent is present at a concentration of up to about 15% by weight.

9. The coating composition of claim 1, where R<sup>1</sup> has 18 to 23 carbons and at least one unsaturated carbon-carbon bond.

10. The coating composition of claim 1, where the reactive diluent is an ester condensation product of at least one fatty acid and a hydroxy carboxylic acid.

11. The coating composition of claim 10, where the hydroxy carboxylic acid has two to seventeen carbons.

12. The coating composition of claim 10, where the reactive diluent is an ester condensation product of a linseed oil fatty acid and lactic acid.

13. A reactive diluent mixture for use in a coating composition that is curable to a protective film, where the reactive diluent mixture is produced by ester condensation of lactic acid and a mixture of at least two fatty acids obtained from linseed oil.

14. A coating composition that is curable to a protective film, comprising an alkyd, an acrylic resin, and a coupling agent.

15. The coating composition of claim 14, where total volatile organic compound content is less than about 30 grams per liter.

16. The coating composition of claim 14, where the coupling agent is present at a concentration of up to about 2% by weight and includes titanium or zirconium.

17. The coating composition of claim 14, further comprising a reactive diluent, where the alkyd:reactive diluent weight ratio is about 5:1 to about 1:5.

18. The coating composition of claim 14, where the acrylic resin is present at a concentration of about 2% to about 20% by weight.

19. The coating composition of claim 14, further comprising a polyether polyol.

20. The coating composition of claim 19, where the polyether polyol includes an ethoxylated polyol.

21. The coating composition of claim 19, further comprising a multi-functional acrylate monomer.

22. A coating composition that is curable to a protective film, comprising:  
an alkyd, where the alkyd is present at a concentration of up to about 15% by weight;  
an acrylic resin, where the acrylic resin is present at a concentration of up to about 40% by weight; and  
a coalescent, where the coalescent comprises a multi-functional acrylate monomer and a polyether polyol.

23. The coating composition of claim 22, where the acrylate monomer is present at a concentration of about 0.001% to about 0.5% by weight, and the polyether polyol is present at a concentration of about 0.02% to about 2% by weight.

24. The coating composition of claim 22, further comprising up to about 2% by weight of a coupling agent that includes titanium or zirconium.

25. A coating composition that is curable to a protective film after application to a surface, the composition comprising:

an acrylic resin at a concentration of up to about 40% by weight;

a coalescent comprising a multi-functional acrylate monomer and a polyether polyol; and

a coupling agent.

26. The coating composition of claim 25, where the coupling agent is present at a concentration of up to about 2% by weight and includes titanium or zirconium.

27. The coating composition of claim 25, further including an acrylamide pH modifier.

28. The coating composition of claim 27, where the acrylamide pH modifier is a tertiary amine.

29. The coating composition of claim 25, where the acrylate monomer is present at a concentration of about 0.001% to about 0.5% by weight and the polyether polyol is present at a concentration of about 0.02% to about 2% by weight.

30. A concentrated dispersion composition suitable for dilution with water, detergent, or other additives, to produce a diluted composition for pigment dispersion and preparation of a curable coating composition, the dispersion composition comprising:

a coupling agent, where the coupling agent is present at a concentration of about 1% to about 30% by weight; and

a polyether polyol, where the polyether polyol is present at a concentration of about 3% to about 60% by weight.

31. The dispersion composition of claim 30, where the coupling agent and the polyether polyol are present in a weight ratio of about 1:50 to about 2:1.

32. The dispersion composition of claim 31, where the polyether polyol includes an ethoxylated polyol.

33. The dispersion composition of claim 31, where the polyether polyol includes a butoxypolyglycol.

34. The dispersion composition of claim 30, further comprising a pH modifier at a concentration of about 2% to about 60% by weight.

35. The dispersion composition of claim 34, where the pH modifier includes an acrylamide compound.

36. The dispersion composition of claim 34, where the coupling agent and the pH modifier are present in a weight ratio of about 5:1 to about 1:20.

37. The dispersion composition of claim 31, further including a freeze-thaw stabilizer.

38. The dispersion composition of claim 37, where the freeze-thaw stabilizer includes a polyvinyl alcohol at a concentration of up to about 20% by weight.



39. The dispersion composition of claim 31, further including vanillin at a concentration of up to about 3% by weight.

40. A dispersion composition suitable for dilution with water, detergent or other additives, to produce a composition for pigment dispersion and preparation of a coating composition, the dispersion composition comprising:

a first part that comprises a coupling agent and a polyether polyol; and

a second part that is substantially aqueous and constitutes up to about 95% of the dispersion composition by weight.

41. The dispersion composition of claim 40, where the coupling agent is present in the first part at a concentration of about 1% to about 30% and includes titanium or zirconium.

42. The dispersion composition of claim 40, where the polyether polyol is present in the first part at a concentration of about 3% to about 60% by weight.

43. The dispersion composition of claim 40, where the coupling agent and the polyether polyol are present in the composition in a weight ratio of about 1:50 to about 2:1.

44. The dispersion composition of claim 40, where the composition further comprises an acrylamide pH modifier.

45. The dispersion composition of claim 40, where the pH modifier is present in the first part at a concentration of about 2% to about 60% by weight.

46. A concentrated alkyd composition for use in producing a coating composition that is curable to a protective coating and has a total volatile organic compound content less than 30 grams per liter, the alkyd composition comprising:

an alkyd that is present at a concentration of about 10% to about 80%; and

a reactive diluent that comprises one or more carboxylic acids with the formula  $R^1-(C=O)-OH$ , where  $R^1$  has 8 to 35 carbons and includes an ester linkage.

47. The alkyd composition of claim 46, where  $R^1$  has the formula  $R^2-(C=O)-O-R^3-$ ,  $R^2$  is a moiety of 3 to 23 carbons, and  $R^3$  is a linker of 1 to 16 carbons.

48. The alkyd composition of claim 46, where the reactive diluent is present at a concentration of about 10% to about 80% by weight.

49. The concentrated alkyd composition of claim 46, where the alkyd and the reactive diluent are present in a weight ratio of about 5:1 to about 1:5.

50. The concentrated alkyd composition of claim 46, where the alkyd is produced from an oil that comprises linseed oil or tung oil.

51. A concentrated alkyd composition for use in producing a coating composition that is curable to a protective coating and has a total volatile organic compound content less than 30 grams per liter, the alkyd composition comprising:

an alkyd present at a concentration of about 10% to about 80% by weight; and

a coupling agent present at a concentration of about 0.5% to about 15% by weight and including titanium or zirconium.

52. The alkyd composition of claim 51, further comprising a reactive diluent at a concentration of about 10% to about 80% by weight.

53. The alkyd composition of claim 52, where the reactive diluent comprises one or more carboxylic acids with the formula  $R^1-(C=O)-OH$ , and  $R^1$  has 8 to 35 carbons and includes an ester linkage.

54. The alkyd composition of claim 51, further comprising a detergent at a concentration of about 0.01% to about 3% by weight.

55. The alkyd composition of claim 51, further comprising an acrylamide pH modifier that is present at a concentration of about 0.5% to about 10% by weight.

56. The alkyd composition of claim 51, further comprising a drying agent.

57. A concentrated coalescence composition that is suitable for use in preparing a curable coating composition, the coalescence composition comprising:

an acrylate monomer at a concentration of about 2% to about 50% by weight; and  
a polyether polyol at a concentration of about 10% to about 90% by weight.

58. The coalescence composition of claim 57, further including vanillin at a concentration of up to about 2% by weight.

59. The coalescence composition of claim 58, where the vanillin and the polyether polyol are present in a weight ratio of about 1:10 to about 1:1000.

60. A method of dispersing pigment during preparation of a curable coating composition, comprising:

combining at least one pigment with a dispersion composition to produce a mixture, where the combining step results in dis-agglomeration of the pigment;

provided that the mixture comprises a titanium or zirconium coupling agent at a concentration of about 0.004% to about 1.2% by weight and a polyether polyol at a concentration of about 0.012% to about 2.4% by weight.

61. The method of claim 60, where the mixture further comprises an acrylamide pH modifier at a concentration of about 0.1% to about 10% by weight.

62. The method of claim 60, where the mixture further comprises a freeze-thaw stabilizer at a concentration of up to about 0.8% by weight.

63. The method of claim 60, further comprising diluting a concentrated dispersion composition about 10-fold to about 2000-fold to produce the dispersion composition, where the concentrated dispersion composition provides the coupling agent and the polyether polyol for the dispersion composition.

64. A method of dispersing pigment during preparation of a curable coating composition, comprising:

combining at least one pigment with a dispersion composition to produce a pigment mixture, where the combining step results in dis-agglomeration of the pigment;

provided that the pigment mixture comprises a titanium or zirconium coupling agent at a concentration of about 0.004% to about 1.2% by weight, and an acrylamide pH modifier at a concentration of about 1% to about 10% by weight.

65. The method of claim 64, further comprising diluting a concentrated dispersion composition about 10-fold to about 2000-fold to produce the dispersion composition, where the concentrated dispersion composition provides the coupling agent for the dispersion composition.

66. A method of producing a coating composition that is curable to a protective film, comprising:

mixing an alkyd composition and a water-based mixture, where the alkyd composition comprises an alkyd and a reactive diluent, the alkyd and reactive diluent are each present at a concentration of about 10% to about 80% by weight, and the alkyd is diluted about 2-fold to about 40-fold by mixing.

67. The method of claim 66, where the water-based mixture comprises at least one pigment at a concentration of at least about 30% by weight.

68. The method of claim 66, where the alkyd composition further comprises a coupling agent at a concentration of about 0.5% to about 15% by weight.

69 The method of claim 66, further comprising the step of adding an acrylic resin to a final concentration of up to about 40% by weight.

70. The method of claim 66, further comprising the step of adding a coalescent composition that includes at least two coalescents.

71. A method of producing a coating composition that is curable to a protective film, comprising:

combining a coalescent composition with a water-based mixture that includes a binder, where the coalescent composition is diluted at least about 50-fold when combined and comprises at least two coalescing agents.

72. The method of claim 71, where the binder comprises an alkyd and an acrylic resin.

73. The method of claim 71, where the at least two coalescing agents include a polyether polyol.



74. A method of producing a coating composition that is curable to a protective film, comprising the steps of:

diluting a concentrated dispersion composition about 10-fold to about 2000-fold with water and pigment to make a pigment dispersion adapted to dis-agglomerate the pigment upon mixing;

combining binder with the pigment dispersion to make a binder mix; and

combining a concentrated coalescent composition with the binder mix, where the coalescent composition is diluted at least about 50-fold when combined.

75. The method of claim 74, where the concentrated dispersion composition includes a titanium or zirconium coupling agent.

76. The method of claim 74, where combining binder includes addition of a concentrated alkyd composition, where the concentrated alkyd composition includes an alkyd at a concentration of about 10% to about 80% by weight.